

REVIEW OF CLINICAL APPROACH TO STRESS
IN COMMERCIAL TRANSPORTATION VEHICLE OPERATORS

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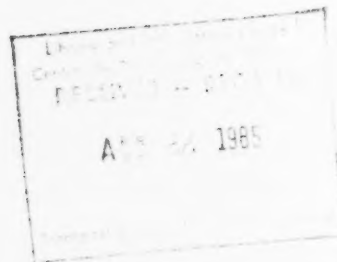
**REVIEW OF CLINICAL APPROACH TO STRESS
IN COMMERCIAL TRANSPORTATION VEHICLE OPERATORS**

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17. Abstract This report reviews clinically oriented literature relevant to understanding the effects of psychological stress in commercial vehicle operators in all major modes of transportation. The report begins by describing the background of research and theories supporting the idea that stress causes physiological reactions whose effects accumulate over time, eventually leading to premature incidences of degenerative diseases such as heart disease. The report then describes research findings about stress in vehicle operators and in members of other occupations. The main findings of the review were that: although there is strong circumstantial evidence that stress causes significant occupational health problems, this remains to be shown conclusively. There has been little research on stress in vehicle operators but there is also little direct or indirect evidence that stress is a greater problem in vehicle operation than in other occupations. Due to the underdeveloped state of basic research on occupational stress, it was concluded that it would be premature to pursue advanced technical research and development efforts in this area.					
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17. Résumé Ce rapport fait le point sur les connaissances cliniques concernant l'effet psychologique du stress sur les conducteurs de véhicules de transport urbain et routier. Il présente les théories et les résultats de recherche mis de l'avant pour étayer la notion que le stress a des effets physiologiques cumulatifs dans le temps, entraînant l'occurrence prématurée de lésions de l'organisme, le système cardiovasculaire, par exemple. Il décrit ensuite les observations faites sur le stress parmi les conducteurs de véhicules de transport, comparativement aux personnes qui exercent d'autres métiers. La principale constatation est la suivante: il existe en effet de fortes présomptions concernant l'effet marqué du stress sur la santé en milieu de travail, mais cet effet doit encore être démontré de façon concluante. Il y a eu peu de recherche sur le stress parmi les conducteurs de véhicules de transport, et rien n'a encore été observé pouvant prouver implicitement ou explicitement que l'effet du stress sur ce groupe de personnes est plus marqué que sur tout autre groupe de travailleurs. Vu l'état embryonnaire de la recherche fondamentale sur le stress en milieu de travail, le rapport en arrive à la conclusion qu'il serait prématuré de lancer un programme de recherche et de développement techniques dans le domaine considéré.			
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REVIEW OF CLINICAL APPROACH TO STRESS IN COMMERCIAL TRANSPORTATION VEHICLE OPERATORS

This report describes a review of the literature on stress in commercial transportation vehicle operators. The purposes of the review were to:

- 1 Summarize the findings of reported literature on stress in vehicle operators;
- 2 Evaluate methodologies used in stress research;
- 3 Identify research and development opportunities related to vehicle operator stress.

The review was intended to cover all commercial modes of transportation including; marine, rail, road, and air. The scope of stress literature covered in the review included research on stress in all of its occupational manifestations; and research on all sources of stress except those associated with stress due to operator workload.

The review was structured to have a classical clinical perspective of stress and its effects. The subjective experience of stress is generally indistinguishable from what has long been known as anxiety. The recent popular and scientific interest in stress comes from findings suggesting that the consequences of stress are considerably more serious than older knowledge about anxiety suggested.

The major reason for the widespread research interest in stress comes from findings that suggest that serious health and behavioural problems can result from being subjected to unwanted stress. The outcomes of stress are thought to include Coronary Heart Disease (CHD) and other forms of physical ill health; mental ill health outcomes ranging from suicide to alcohol abuse; and various forms of loss of ability to perform at work or maintain satisfying social relationships. However, the evidence that stress has these major physical and mental health consequences, while persuasive, is nevertheless circumstantial. As well, there are no theories of stress that provide satisfactory insights into how stressful stimulation might eventually lead to the types of health consequences that are now attributed to stress. Finally, of consequence to this report, there has been very little research on stress in vehicle operators.

The contents and structure of this report will reflect an attempt to bring order to the present considerable confusion over what stress is; how it works; and what its outcomes are. In trying to bring order to this confusion, the report will aim to clarify issues and priorities about vehicle operator stress that are of concern to the transportation industry.

The layout of the report will be as follows. We will start by describing the literature search methodology. Then we will describe the historical background of stress research, and in doing so, describe the main

approaches to defining stress, particularly ones that would likely be most useful in dealing with concerns about stress in vehicle operators. We will then describe the main theories that have been proposed to describe and explain the causes of stress, and reactions to stress. Next, we will describe the stress research findings relevant to vehicle operation. These will include firstly, a small group of findings obtained from research on vehicle operators, and then, a description of a larger body of findings from research on stress in other occupations. In the process of describing previous findings, we will be able to demonstrate the various methodological problems associated with detecting stress causes and outcomes. After we have summarized the previous findings, we will develop arguments for the kinds of research that might be done on stress in vehicle operators.

LITERATURE SEARCH METHODOLOGY

Three literature data bases provided the bulk of the references. TRIS (Transportation Research Information Service), PSYCHINFO (the American Psychological Association data base of literature in Psychology), and NTIS (National Technical Information Services). Using only the key word "stress" as a search term yielded about 25,000 articles from these three data bases combined. Since articles may appear in more than one data base, and in more than one publication, it is difficult to estimate precisely the total number of individual articles.

Despite the large number of articles that used stress as a descriptive term, applying search terms such as vehicles, operator, transportation, marine, air, and so on; left only a few articles that were at all relevant to the purposes of this review. Having found only a few articles on stress directly relevant to the subject of this review, we broadened the search to the general Occupational Stress literature in search of material that could be used to draw inferences about stress in vehicle operation.

In addition to articles, we drew upon a number of books published in recent years about stress, and on library holdings, particularly the University of Toronto holdings.

HISTORICAL BACKGROUND

Stress has been given, in recent years, a great deal of attention in popular literature, and in applied technical literature. The amount of attention given to stress gives the impression that it is a newly discovered phenomenon. In fact however, stress as a phenomenon has been studied since the nineteenth century.

During the nineteenth century, medicine began to recognize the existence of physical ailments that appeared to have no basis except in the mind of the sufferer. At first, such ailments were treated as more or less isolated cases of hysteria. However, it was in treating such ailments, that Freud, and his contemporaries, began to develop theories about human psychodynamics. Soon, the concept of psychological stress created by conflicts and pressures became fundamental to ideas about personality development. Further, it was thought that defenses against psychological stress could produce physiological reactions including not only the obvious sympathetic and parasympathetic nervous system reactions, but specific diseases.

According to the early theories, conflicts between individual goals; such as performing as required at work and meeting the requirements of home life; could become strong enough to lead to severe emotional strain and mental illness. In certain cases, so it was thought, the symptoms resulting from this strain appeared as physical illness, or as it was called, psychosomatic illness. During World War I, it also became apparent that the pressures of modern warfare produced far more widespread psychological stress reactions than had ever been recognized before.

The experience of World War I seemed to confirm the proposition put forward earlier, that the mental aspects and the physiological aspects of well-being are intimately related to one another. For the next thirty years an underlying theme in psychological research was to uncover the relationship between physiological events and mental events. For example, theories of motivation and learning have defined basic physiological needs as the foundation for the more complex and abstract forms of human motivations. In abnormal psychology, a great deal of effort went into identifying organic causes of abnormal behaviour; and into identifying mental illnesses that were primarily caused by organic conditions.

Although since the turn of the century, there had been a major movement in medicine towards the "wholistic" treatment of the mental and physical person as one; the significant feature of treatment and research up until 1950, was the tendency to see physical illness and mental illness as separate and distinct conditions. Mental illnesses, and a few emotionally related diseases such as ulcers were seen as sudden breakdown reactions to psychological stress. Physiological illnesses were treated as outcomes of biological or physiological causes. Thus, although the links between emotional and physiological states were well recognized in theory, they tended to be ignored in practice.

This began to change when Hans Selye (Selye and Fortier, 1950, cited in Coleman, 1972) began to publish his now well known work. The change that Selye brought about was to suggest that stress reactions need not be simply

sudden and temporary breakdowns resulting from sudden and temporary stresses; but that the effects of even mild continuous stress are cumulative, and may eventually lead to any of a wide variety of serious disease conditions. Although Selye had his ideas well enough developed to publish in a book in 1956, (Selye, 1956), it was not until about 1970 that his work began to generate large scale research by others.

As Selye continued to publish his findings, it became more and more evident that major diseases such as Coronary Heart Disease (CHD) might be the result of an accumulation of long-term stress. Coincident with this thinking, was the fact that CHD mortality was rapidly increasing during the late 60's and early 70's. The possibility of preventing this major disease through good mental health was, and still is, an attractive one. Furthermore, if stress had cumulative ill health effects, it became attractive to view mental well-being as not just a hedonistic desire, but as a critical requirement for preventing disease. In turn, it became attractive to investigate stress in the work place, and its possible effects on not only employee illness or mortality, but also on such things as performance, productivity, absenteeism, accidents and so on.

From the overall historical perspective, the properties and dynamics of stress have been recognized for a long time; and for a long time, they have probably been understood nearly as well as they are now. The conditions for stress are a person's perceived inner conflicts or pressures that lead, usually, to emotional reactions such as anxiety, anger, or depression; and along with these emotional reactions, to physiological reactions such as nervous system reactions, cardiovascular reactions, immune reactions, and the like. These primary physiological reactions can act as catalysts for a chain of physiological reactions building, sooner or later, to any of a wide range of illnesses. Although the path of thinking about how stress works has been a gradual one, there has been in recent years a major change in thinking about the outcomes of stress; in particular, it is now thought that the accumulated effects of what were thought to be acceptable amounts of stress, in fact lead to major disease.

Definition of Stress

The historical evolution in the understanding of stress has not led to a rigorous definition of stress.

Throughout many years, the textbook definition of stress was essentially the same as it is now; "any condition impinging on the organism which require adjustive reactions," (Coleman, 1956); and in a later edition of the same textbook; "any adjustive demand that requires coping behaviour" (Coleman, 1972).

These textbook definitions of stress do not satisfy the needs of someone doing research on stress; who for example, must be concerned about defining dependent and independent variables, causes and effects, and so on. Neither do the textbook definitions satisfy the needs of anyone who seeks meaning and clarity in a definition. However, increasing research effort on stress, particularly on occupational stress, has produced a number of definitions that are at least more elaborate, if not more meaningful.

Sharit and Salvendy (1982) show that research on stress has led to definitions of stress, each of which reflects the research or theoretical perspective of the person making the definition. Selye (1973), for example, focuses on the non-specific physiological responses to stress stimulation. For Selye, the textbook definition of stress is an adequate one: any stimulation produces stress. What differentiates one type of stress from another is the degree of the physiological response; and degree of the stress producing stimulation on the continuum from extremely unpleasant stimulation to extremely pleasant stimulation. Mason, as described in Sharit and Salvendy, argues a more classical view that the definition of stress should reflect the existence of specific illness reactions to specific sources of stress.

Another class of stress definitions (Lazarus and Monat, 1977), includes classical views of stress by referring to how people go about coping with stress. Thus, these definitions include reference to the behaviours required for a person to cope with stress. However, attempting to define stress in terms of behaviours used to cope with stress soon leads to having to include the whole range of factors that influence coping behaviour; early learning, genetic makeup, culture, and so on. Thus, attempting to produce a more comprehensive definition of stress generally yields a definition that is just as vague as the textbook definition.

People doing research on occupational stress have run into similar problems in trying to develop operational definitions of stress that reflect both the sources of stress and outcomes of stress. Sharit and Salvendy argue that a definition of stress that is useful in occupational stress research has to include means for; 1) identifying task dimensions relevant to producing stress; 2) determining optimum regions of objective and subjective response to stresses on these dimensions; 3) defining measurement units that are equivalent for different dimensions; and 4) determining weights for the dimensions in a manner that would determine priorities for dealing with stress sources or outcomes in a given occupational situation.

A definition of stress that met all the criteria listed in the last paragraph would be more than just a definition. It would amount to a comprehensive and quantitative theory of stress. As will be seen in the next section, such a theory does not yet exist.

Theories of Stress

In connecting the word theory with the word stress, one has to use the word theory loosely.

There are three general approaches to theories of stress; firstly, Selye's theory, and positions derived from Selye's theory; secondly, positions derived from the Yerkes-Dobson Law which stated that the level of an individual's performance on a task is a maximum when motivation for performing that task is at an optimum, neither too high nor too low; and finally, theories that try to describe the behavioural and environmental dynamics of stress.

Selye's theory describes a stress reaction as having three phases: 1) an alarm and mobilization phase during which the individual becomes alerted to a stress and mobilizes resources to adjust to the stress; 2) the stage of resistance during which the individual uses resources to resist or adjust to the stress; and 3) the phase of exhaustion during which adjustive resources are exhausted and the individual breaks down and dies. The process of passing through these three phases is called the General Adaptation Syndrome.

The General Adaptation Syndrome does not occur dramatically, at least not typically. Although Selye showed quite dramatic instances of the General Adaptation Syndrome in animal experiments, the typical process consists of a series of stress reactions. In each one, the individual responds to a stress by mobilizing resources until an adjustment is made to the stress, and then the individual recuperates. However, recuperation is never totally complete. Instead, reaction to the stress always uses up some resources that can never be replaced. Over the long term the accumulated effects of stress are to exhaust all the individual's resources. According to Selye, the degenerative diseases that are the main causes of mortality in older age groups, are diseases that result from the General Adaptation Syndrome.

There is a great deal of circumstantial evidence to support the picture presented by the General Adaptation Syndrome (Mason, 1975 a, 1975 b). However, there are several matters at issue concerning the theory. Firstly, Selye concentrated his research on endocrine reactions, and held the view that physiological responses to stress while triggered by endocrine reactions, were nevertheless non-specific to the type of stress being reacted to. Others, Mason for example, believe that stress reactions should be specific to the type of stress, and to the constitution of the individual responding to the stress.

Another issue concerns the psychodynamics of reactions to stress. There is nothing in Selye's theory to account for the psychological differences among individuals that appear to affect stress reactions, particularly the ability to cope with stress. Another issue concerns defining what constitutes stressful stimulation. Selye conceived stress stimulation as a continuum from extremely unpleasant stimulation to extremely pleasant stimulation. Along this continuum, virtually all stimulation requires adjustive responses; but the required stress reaction is a minimum somewhere in the neutral region between extremely unpleasant and extremely pleasant.

The idea of an optimum stimulation level complements the idea of an optimum arousal level in the Yerkes-Dobson Law, or "inverted U" theory we will describe next. As will be seen however, research on the inverted U theory suggests that defining the neutral point on the stress continuum is not so simple as it might sound.

There is a rich history of research on skilled performance, originally derived from military applications. One branch of this research is concentrated on the effect of level of arousal on performance, particularly the effects of fatigue, boredom, and motivation. Up until Corcoran (1962), the effects of arousal on performance had been described primarily in terms of motivation, or factors affecting motivation. Corcoran began discussing stimulation affecting skilled performance as stressful stimulation instead of as arousal stimulation. Since that time there has been a general shift in

thinking so that most of the work on performance under some degree of pressure is described as performance under stress (Hockey, 1983).

We will not discuss all the theoretical issues connected with arousal theories of stress since these issues fall under the heading of operator workload stress. We will discuss one of the issues however, because it is relevant to the methodology consistently used in much of the research on occupational stress. This issue has to do with defining the conditions under which external stimulation constitutes a source of stress in performing a task. Research shows that physical sources of stress such as heat, noise, and the like; and psychological sources of stress such as fatigue, boredom, and the like; all have different types of effects on performance, and they all have different interaction effects with one another. Moreover, the effect of any particular source of stress depends on the type of task being performed. Because of the complexity of stress effects on performance, it has been found to be extremely difficult to define optimum levels of stimulation that minimize stress in any given situation.

The two theoretical approaches just described, are not particularly in conflict, because they deal with different aspects of stress, and deal with stress in different contexts. Theoretical thinking and research derived from the General Adaptation Syndrome focuses on the general and long term effects of stress on physiological and mental health. Theoretical thinking and research on theories of how stress affects skilled performance focus on the performance of a specific task, particularly on the interaction between the task and the person performing the task. In terms of vehicle operators, the focuses of General Adaptation theory is on the total circumstances of the vehicle operator, whether in the vehicle or not. The focus of theories related to performance under stress is on the task of operating the vehicle itself.

There are also some scientific motivational differences between the General Adaptation and the arousal approaches. The bulk of work done in connection with the General Adaptation Syndrome is motivated by the possibility that stress produces illness and mortality. Research on the effects of stress on performance has been motivated, primarily, by the desire to understand the mechanics of skilled performance, particularly the mental information processing components that determine the difference between high levels and low levels of performance. In fact, it may be misleading to think of stress in the General Adaptation Syndrome context as being qualitatively the same as stress in the skilled performance situation.

The third set of theories of stress focus on behavioural variables that mediate stress reactions. The best known conceptualization of a relationship between stress and behavioural variables is the theory of Type A and Type B Behaviour profiles (Jenkins, Rosenman, and Zysanski, 1974). People who exhibit Type A behaviour are hard driving, competitive, impatient, and constantly worrying about themselves and others. Type B behaviours are just the opposite. Measurement of Type A-B behaviour was originally based on a behavioural observation scale, but it has since been developed as a self-report paper and pencil test.

There is a consistent tendency for Type A persons to show a higher risk of heart disease than the risk faced by Type B persons. While it is

tempting, or convenient, to think of the Type A-B theory as a theory of personality, it is in fact a description of a behaviour continuum rather than a theory of personality. That is, Type A-B behaviour is not necessarily associated with any classical personality theory. However, it remains to be seen whether or not there is a genuine causal link between Type A behaviour and heart disease; and whether or not Type A behaviour can be manipulated to reduce the risk of heart disease.

Despite its wide popular appeal, the Type A-B theory of stress has not generated as much research as another theoretical approach represented by the Person-Environment (P-E) fit model of French and his associates (French, 1973). The P-E fit model describes stress as a health outcome caused by a good or bad fit between the individual and his or her job environment. The cause of a good or bad fit is the extent to which the job meets the individual's needs.

The P-E fit model lists as properties of the person that are relevant to the person-job fit: the person's objectively defined motives and abilities; the person's own perceptions of his or her motives and abilities; and the person's available defenses against job pressures and barriers to fitting with the job. Relevant properties of the environment are: the objective social environment, including the person's occupation; the person's subjective social environment, including perceived need fulfillment, and perceived job demands, and the person's subjective support system including support from supervisor, other workers, relatives, and so on. Both environmental properties and personal properties act to determine whether or not the person's motives for working are met by the job; and whether or not the person has the ability to meet the requirements of the job. When the job fails to meet the person's needs, or the person's abilities fail to meet the demands of the job, the result is stress on the person, leading to health outcomes such as psychosomatic complaints, and disease.

Blau (1981) points out that the P-E model is similar to the Minnesota model of work adjustment (Dawis, England, and Lofquist, 1968; cited in Dunnette, 1976). The difference between the two models is that the Minnesota model has adjustment to work as the outcome where the P-E model has health as the outcome.

Another behavioural model of stress is one developed by House (1974) as a list of factors to be considered in occupational stress research. These include external social conditions; individual perception of stress; responses to stress (subdivided into physiological, cognitive, and behavioural responses); stress outcomes, (subdivided into physiological, cognitive, and behavioural outcomes); and finally, a catch-all of conditioning variables that would include such things as prior learning, and the like. There do not seem to be any examples of literature in which this approach to defining stress was successfully used to conduct a comprehensive piece of research on occupational stress, or otherwise gain some new insight into occupational stress.

It is probably fair to summarize theoretical thinking about stress as being attempts to organize a complex collection of factors about stress into a general, or average, picture of how stress works. All theories, at least theories of life stress, recognize that to describe any one individual's

response to stress, would require knowing a great deal about the individual and his or her circumstances. At present, the number of variables that have to be included in a theory of stress is overwhelming relative to the number of variables that can be handled in even the most ambitious research programs. Consequently, the research findings that we describe in the next sections, reflect attempts to test only parts of the theories; and often, simply attempts to test conjectures inspired by theory.

OCCUPATIONAL STRESS RESEARCH FINDINGS

We will review the literature in two sections; firstly, the literature relevant to vehicle operator stress; and secondly, the components that the general occupational stress literature covering occupations most similar to those of different types of vehicle operators. As already mentioned, there is only a very skimpy literature on the subject of stress in vehicle operators. However, this is true of literature specific to virtually any occupation. Occupations that have been investigated in any depth tend to be those handy to departments of medicine, psychology, and social work. Thus, there is substantial literature on the occupations of nurse, social worker, teacher, and so on. Beyond these occupations, research has concentrated on general occupational categories in specific industries; assembly line workers in manufacturing for example. Transportation, like mining, or others that could be named, has not been an industry sector that has received much attention.

A common characteristic of individual pieces of research on occupational stress is concentration on a specific and narrow aspect of stress, usually with only passing reference to any definition of stress, or any theoretical foundation for the work. Consequently it is difficult to find an organizing principle for describing the literature as a whole, or for developing meaningful conclusions. The structure that we have adopted for the present purposes is necessarily somewhat arbitrary. However, it reflects the classifications that the current pieces of research fall into.

We began by sorting findings into those directly relevant to vehicle operators, and into those that would be representative of the general occupational stress literature. We then organized findings into categories that represent what have emerged as common groupings of works on occupational stress. These are; research to identify job characteristics that seem to produce stress outcomes; stress effects of both quantitative and qualitative load; job load demand; organizational factors that influence the occurrence of stress reactions; and approaches to coping with stress.

STRESS IN VEHICLE OPERATION

There were a total of eight articles that might be considered related to stress in vehicle operation.

Mulders et al. (1982) studied city bus drivers in the Netherlands to test the hypothesis that the high absenteeism record among drivers was due to occupational stress. He studied a sample of 12 bus operators, 6 with low absenteeism and 6 with high absenteeism. He found that the high absenteeism group had higher adrenaline secretion rates in urine samples taken during work periods, and had more heart rate variability during rest periods. He concluded that "high levels of adrenaline and heart rate variability occurred together in drivers who apparently are more vulnerable as evidenced by the absence rate."

Subjective feelings about being under stress were not measured, nor were there any measures of work capacity, driving skill, accident rates, or anything else that might suggest differences in coping style. From such a small study sample, it is difficult to have much confidence in the generalizability of this finding, not to mention the meaningfulness of the finding, if any.

In another study of bus drivers, Hartman (1982) developed the hypothesis (it is not exactly clear why), that bus drivers are under stress. His attempts to support this conclusion consisted entirely of anecdotal evidence. The following quote gives the flavor of the evidence: "After being verbally harassed by a male passenger for ignoring his sexual overtures, a female bus driver continues her route but is unable to restrain the flow of tears. Eventually she needs hospital care for bleeding ulcers." This type of evidence is used to support the use of small group sessions to get people to discuss their problems on the job, and in outside life.

Haynes and Hopkins (1983), in a paper titled "An Innovative Approach to Bus Operator Training" argue for a training program that uses self-paced lecture and discussion training. However, the article contains only the vaguest allusion to what effect the program might have on preventing stress.

Spicher (1982) produced an article with the promising title, "Review of Literature Related to Bus Operator Stress". As it turned out however, Spicher could not find any literature to review. Nevertheless, it was concluded that stress in bus operators results from an interactive process; some stress results from personal characteristics of the bus operators, and some results from interaction between working environment and personal characteristic. It was argued that operators can be trained to modify the personal characteristics which cause them stress; and that managers and supervisors can develop ways to modify the operator working environment to moderate stress effects. Finally, it was argued that operators can be trained to deal with on-the-job stressful situations. While all of this makes a certain amount of sense, there was no evidence presented to support any of the arguments.

Blau (1981) studied 123 bus drivers, primarily to test the usefulness of the Person-Environment fit model of French. Blau drew a number of

conclusions from the Person-Environment fit model, all related to the hypothesis that job stress produces lowered satisfaction and lowered performance. Blau found a correlation between job stress as measured by questionnaire and employment records, and job satisfaction; but there was no relationship between job stress and ineffective job performance, where job performance consisted of a composite of chargeable accidents, suspensions, unexcused absence, lateness, supervisory reports and public relations reports. Length of service was found to be an important intervening variable. Long service employees were better performers and more satisfied with their jobs. Although the results contained isolated correlations predicted by the Person-Environment fit model, the general weight of evidence did not support the model.

Drory (1982) studied the relationship between boredom, intellectual capacity, and work effectiveness in 93 drivers driving heavy trucks on a 250 mile stretch of desert road. Boredom was measured by means of a questionnaire. Capacity was measured by a questionnaire that asked about how often the driver engaged in intellectual activities such as reading, attending public lectures, and so on. Job performance was measured by incidence of property damage accidents, and absenteeism. The results showed that boredom was experienced by drivers with higher scores on the intellectual capacity scale, but was negatively associated with job performance measures. It was also found that the incidence of property damage accidents was more strongly related to boredom than to absenteeism.

Perry and Long (1984) undertook a study to reduce absenteeism in California transit employees. Three factors in human resource productivity were studied; extra board scheduling, workers' pay, and operator job stress, all of which have been associated in the past with absenteeism. Data were gathered from company records, and through questionnaires. Included in the study was a job stress survey given to 1039 operators, covering experience of hazardous conditions, job incidents, general health, job satisfaction, and specific physiological stress symptoms such as back pain, insomnia, and so on. Job attitudes were found to be related to experience of environmental stressors such as dangerous equipment, pollution, and noise; and to employee abuse by passengers. The frequency of reporting health symptoms increased as negative job attitudes increased. Environmental stressors and abuse by passengers were the strongest predictors of health symptoms.

Conclusions drawn by Perry and Long were only loosely related to the data gathered in the study, or the questions that the study was meant to answer. The main recommendation was to improve supervisor competence and supportiveness; although there was little concrete evidence given to sustain this recommendation. On the matter of explaining sources of job stress; it was difficult to decide if the job environment produced stress directly by having to keep up with tight schedules; or whether tight schedules caused passengers to abuse drivers.

Alkov and Borowski (1980) studied life changes, personality factors, judgmental and leader qualities in air crew members involved in 98 accidents. The group was divided into fault and no fault groups. It was found that those in the fault group had trouble with interpersonal relationships, lacked a sense of humor about themselves, were immature, or had recently lost a friend or a family member to death.

Shiple and Cook (1979) studied job satisfaction in marine ship pilots, including exposure to, and experience of stress. On average, pilots were well satisfied with life and work. Blood pressure measures were used to discriminate between fit and less fit pilots. Associated with high blood pressure were: higher alcohol consumption, more expressions of unhappiness, more sleep problems, lower self-esteem, and higher experienced anxiety level. Pilots who did not like their jobs had low tolerance for ambiguity and frustration, low job involvement, and lower levels of personal characteristics suited to the job. Tolerance for uncertainty was the largest factor associated with poor job fit. As part of the study electroencephalograph (EEG) records were monitored. Peaks of EEG activity occurred during boarding and disembarking, and when vessels, particularly large vessels, were being maneuvered in confined waters.

The articles just described represent ones that contained attempts to consider stress relationships within the vehicle operator job. Of these few articles, at most, one or two might be considered as attempts to directly study stress in operators of some type of vehicle. For the most part, the consideration of stress was only one aspect of a study; or conversely, vehicle operation was incidental to the study of stress.

GENERAL OCCUPATIONAL STRESS FINDINGS

A number of comprehensive review articles on occupational stress have appeared in recent years. They are: Beehr (1978), Cooper and Marshall (1976), Mikhail (1981), Schuler (1980), and Sharit and Salvendy (1982). Significant books on the subject included: Alluisi and Fleishman (1982), Buck (1972), Cooper (1983), Cooper and Payne (1978), Cooper and Payne (1980), Corlett and Richardson (1981), Farber (1983), Krohne and Laux (1982), Mackay and Cox (1979), Marshall and Cooper (1981), McGrath (1970), McLean (1974), and McLean (1979).

The review papers just listed, represent hundreds of articles on stress. The following paragraphs give what is meant to be a representative sampling of the individual pieces of works covered in the reviews. The classifications that we will use for describing this work are ones that seem to have evolved circumstantially as results have accumulated. Generally, the classifications represent different approaches to finding causes of occupational stress; and implicitly, different approaches to finding cures for occupational stress.

Factors Intrinsic to a Job

This branch of occupational stress research has aimed at whether or not there are certain occupations that are subjected to more or less stress than others; and whether or not there are identifiable sets of characteristics of jobs that determine the stress potential of the job.

Kornhauser (1965) found that poor mental health was directly related to unpleasant work conditions, necessity to work fast, and necessity to expend high levels of physical effort. Kornhauser's investigation of assembly line jobs led to the conclusion that paced assembly lines are associated with high stress.

A number of studies have concentrated on showing relationships between a person's occupation and incidence of heart attack; on the premise that high rates of heart attack indicate high levels of stress. Thus, Guralnick (1963, cited in Shaw and Riskind, 1983) found that high stress occupations included ones such as lawyer, physician, and insurance agent; and low stress occupations included ones such as college president, college professor, and teacher (Colligan, Smith and Hurrell, 1977).

Shaw and Riskind (1983) used data from the Colligan, et al. study; along with data from two other studies to see whether the Position Analysis Questionnaire (PAQ) (McCormick, 1976) to see if the PAQ could be used as a predictor of the stress level of an occupation. The PAQ is a generalized job analysis instrument that measures, for any particular job, various generic job characteristics such as: requirement to deal with spatial information; requirement to perform manual activity; and so on. Shaw and Riskind combined the existing large data base of PAQ information with data from studies of occupational mortality, and showed that certain PAQ dimensions consistently appeared in occupations with high incidences of stress associated diseases; heart disease, hypertension, ulcers, and so on. Of relevance to vehicle

operator stress, was the finding that the PAQ dimension called performing "controlled manual, and or related activities", was one that consistently appeared in occupations with high incidences of stress diseases. This PAQ dimension is a major descriptive characteristic of the task of vehicle operation.

Quantitative Overload

A number of studies have been designed to determine the relationship between the volume of work a person has to do and the occurrence of stress symptoms or outcomes. Russek and Zohman (1958, cited in Cooper and Marshall, 1976) found in a study of 100 young coronary patients that 25% of them worked at two jobs; or worked 60 or more hours a week. Breslow and Buell (1960, cited in Cooper and Marshall, 1976) found that workers who worked more than 48 hours a week suffered a higher than average rate of heart attacks. Margolis et al. (1974, cited in Cooper and Marshall, 1976) found that work overload was significantly related to excess drinking, absenteeism, low motivation to work, and low self-esteem.

Qualitative Overload

Qualitative overload means having work that does not have to be done at a high rate; but is difficult to do by virtue of its complexity, or sometimes, by virtue of a low probability of achieving the goals of the work. Qualitative overload is usually associated with jobs that require intellectual effort. For example, French, Tupper, and Mueller (1965, cited in Cooper and Marshall, 1976) found that low self-esteem in professors was related to qualitative work overload, while administrators did not suffer from such symptoms. A number of studies reviewed by Marks (1967, cited by Cooper and Marshall, 1976) suggested that risk of heart disease rises with occupational level; and presumably, with level of work difficulty. However, Cooper and Marshall point out that a number of studies of specific companies or occupations contradict to Mark's general findings. Thus, even if a particular occupation is vulnerable to stress on the average, this vulnerability can be overcome by compensating organizational climates.

Studies of qualitative overload tend to show more consistent patterns of stress symptoms than they show consistent patterns of higher risk of stress related diseases. French and Caplan (1973) summarize the symptoms of qualitative overload as including: job dissatisfaction, job tension, low self-esteem, withdrawal, signs of embarrassment with achievement, high cholesterol levels, increased heart rates, high levels of Galvannic Skin Response, and higher incidence of smoking.

Organization Characteristics

There has been a great deal of study of the relationship between stress and organizational behaviour. As most commercial vehicle operators work for an organization, organization characteristics influence vehicle operators as much as any other employee.

A typical procedure is to look at members of a particular organization, or at organizations in a particular industry, or at occupational groupings such as management; and then see whether or not there is a relationship between characteristics of the organization and the incidence of stress symptoms and outcomes. In introducing this research, we will point out that most of the research in this area has been done by clinical researchers using organizational variables as media for investigating stress. Very little of the research has been done by organizational behaviour professionals such as Industrial and Organizational Psychologists even though the domain is within their professional province. (Beehr and Newman, 1978)

Role ambiguity or role conflict can have an effect on the occurrence of stress. Kahn et al. (1964) showed that lack of clarity about work objectives produced lower job satisfaction, job related tension, and lowered self confidence. French and Caplan (1970, cited in Cooper and Marshall, 1976) found that lack of clarity about roles in jobs produced low job satisfaction; feelings of threats to mental health and physical well being; and physiological stress symptoms such as high pulse rate and increased blood pressure.

Role conflict can also have an effect on the occurrence on stress. Role conflicts arise when job demands conflict with one another, or when the individual is asked to do things that he or she does not consider to be part of the job. French and Caplan studied men in an office over a two-hour period, and showed that above average heart rates were strongly correlated with reports of conflicting roles. Shirom et al. (1973, cited in Cooper and Marshall, 1976) studied several different occupational groups; agricultural workers, factory groups, craftsmen, and white collar workers. They found a relationship between role conflict and abnormal electrocardiograph readings in the white collar workers, but not in the other occupations they studied.

Level of responsibility has been studied as a factor in stress symptoms. Wardell et al. (1964, cited in Cooper and Marshall, 1976) found that responsibility for people was correlated with the incidence of heart disease, while responsibility for things was not. Similarly, French and Caplan in their 1970 study also found that responsibility for people was related to heavy smoking, high blood pressure, and high serum cholesterol levels.

Career development has also been studied for relationships with stress. Brook (1973, cited in Cooper and Marshall, 1976) found behavioural disorders in people who were over-promoted or under-promoted. Erikson and Gunderson also found stress symptoms in individuals who's self perceptions did not correspond with their actual organizational status. Taking the career development line of investigation a step further, Shekelle et al. (1969, cited in Cooper and Marshall, 1976) found higher risk of heart disease for men who's social class and childhood was different from the one they belonged to as adults.

Participation in decision-making is another organizational behaviour that appears to be related to stress symptoms. Buck (1972) found that managers and workers who felt themselves to be working in environments of high pressure also reported that management tended to rule arbitrarily, and that there was little freedom to participate in decision-making. Margolis et al. (1974) found lack of participation in decision-making was a consistent and significant predictor of strain and job-related stress. In such environments, they found higher incidence of poor physical health, drinking, expressions of depression and low self-esteem, low life satisfaction, low job satisfaction, low work motivation, expressed intentions to quit the job, and high absenteeism. Finally, Quinn et al. (1971, cited in Cooper and Marshall, 1976) found that symptoms of poor mental health were linked to the presence of close supervision and lack of autonomy in the work.

Some organizational studies have endeavoured to include effects of influences outside of the organization, home life for example, in the organizational variables considered. However, as Cooper and Marshall point out, there do not appear to be any studies attempting to determine whether or not there are specific interactions between organizational variables and the individual's outside life.

Individual Differences in Coping with Stress

An underlying weakness of studies relating stress to occupational characteristics or organizational characteristics, is the consistent difficulty of taking into account the effect that individual differences have on susceptibility to stress. In the case of the relationship between stress and occupational characteristics, Ivancevich and Matterson (1980) pointed out that there is no way of determining whether apparently high stress occupations are intrinsically stressful, or whether people susceptible to stress tend to gravitate towards such occupations. Similarly, studies of organizational characteristics related to stress, although they give substantial weight to personality variables, tend to ignore what are commonly thought to be occupationally relevant individual differences; particularly vocational abilities, aptitudes, and interests.

Jenkins (1971 a, b,) reviewed a large number of studies on the relationships between personality variables and heart disease. In summarizing a number of studies using the MMPI personality inventory results for victims of fatal heart attacks, Jenkins concluded that victims show higher scores on scales related to hyperchondriases, depression and hysteria. Victims show greater general neuroticism, particularly depression. Other studies using the 16 PF personality test results, have shown high scores on emotional stability for patients with angina pectoris. In all cases, these studies have been after the fact, and without any way of assessing to what degree the personality test scores were independent of the presence of the disease. Zaleznik et al. (1977), in a study of a large Canadian Crown corporation, found reliable differences in the stress syndromes shown by workers in different functional areas of the organization, as well as francophone-anglophone differences. However, there were substantial difficulties in determining whether differences in syndromes were due to differences in the environments of functional groups, or differences in the types of persons belonging to the functional groups.

RELEVANCE OF OCCUPATIONAL STRESS RESEARCH TO STRESS IN VEHICLE OPERATORS

In applying previous research to occupational stress in vehicle operators, we must say that previous research does not give us much assistance. There are a number of very specific findings that might apply to specific vehicle operation situations, in specific transportation modes. However, there is little upon which to base any generalizations about stress in vehicle operators.

Blau's study of bus operators is a sound piece of research work; but its focus was almost entirely on testing a theory about stress; with bus operators being more or less incidental to the methodology of the study. Indeed this study virtually ignores what may be of significant interest to the purposes of this report.

Blau used interviews and questionnaires to investigate sources of stress in bus operators. From a Factor Analysis, he found three factors that describe sources of stress for the operator: the first one concerned dealing with passengers and company policies; the second one concerned scheduling and vehicle operating procedures; and the third one concerned physical danger, including accidents and physical threats from passengers. The first factor accounted for about 60% of the variance in the operators' perceptions of sources of stress. The physical danger factor accounted for 15% of the variance. Although the measurement questionnaires were developed from small group discussions with the operators, the workload of the driving task itself never emerged as a general source of stress.

Blau's work contains a nugget of what might be an occupationally specific approach to stress in vehicle operators, not to mention stress in members of any occupation. That is, a systematic model of stress in an occupation has to be specific to the occupation. Blau's factor structure for bus operator might apply to most vehicle operation situations, particularly passenger carrying operations.

Although Factor Analysis is a common analytic technique in occupational stress research, there has been little effort to seek factor structures specific to occupations. Instead, the concentrations of effort has been on factor structures that reflect theoretical positions like those of French, or Jenkins, or House. While these theoretical approaches take into account the effects of occupational and organizational variables, they do so by virtue of the ways that individual personalities respond to occupational stresses. Thus, we can develop some profiles of individual characteristics that predict responses to occupational stresses; but we cannot derive complimentary occupational or organizational profiles that moderate or magnify stress responses. In particular, we have little information on which to base a profile of the characteristics of vehicle operators that might be relevant in predicting the stressfulness of this occupation.

Riskind's et al. study using PAQ dimensions as a predictor of occupation specific stress, found that occupations having a requirement for manual

control skills showed higher incidences of stress related diseases. This suggests that vehicle operation might be, therefore, a stressful occupation. However, Riskind does not give any comparisons between occupations that fall within the general manual control classification; so it is not possible to say if vehicle operation was in fact even one of the occupations that appeared in Riskind's samples.

Another possibly suggestive study is one by Grubert (1976) on the morbidity effects of whole body vibrations in truck drivers. Grubert compared truck drivers with air traffic controllers for incidences of medical conditions that might be associated with being subjected to years to vibration in the driver's seat of a truck. Although, Grubert found conditions in the truck drivers that could be associated with truck vibration, other aspects of the occupation of truck driving could not be ruled out as contributors to these conditions. Of more relevance to the purposes of this report, Grubert found that truck drivers had higher incidences of stress related conditions, such as hypertension, than air traffic controllers did. This suggests at least one vehicle operation occupation that might subject to higher than average levels of stress. On the other hand, the air traffic controller comparison group in this study were subject to a considerably stricter cardiovascular health standard than truck drivers were. Thus, air traffic controllers with significant cardiovascular systems would not keep their medical certifications, or their jobs; while truck drivers with the same symptoms would be permitted to keep their medical certifications, and their jobs.

The Grubert study may be one among many in the transportation industry that contain data relevant to the subject of stress in vehicle operation. However, if it is, the existence of such studies has not led to the apprehension of stress as being a prominent problem in vehicle operation. In sum, there are threads of evidence from individual studies both within the stress literature and outside of it, to suggest that stress is a significant factor in the occupation of vehicle operator; but the only valid conclusion that can be drawn is that stress is no more significant in vehicle operation than it is in other occupations.

CONCLUSIONS TO BE DRAWN FROM PAST RESEARCH ON STRESS

There are three questions that should be answered by research on stress:

1. What is the truth of the hypothesis that stress leads to significant life-shortening disease?

And if the hypothesis is true:

2. What roles do antecedent physiological and psychological factors play in stress reactions?
3. What physiological and psychological dimensions are there to counteract the effects of stress reactions?

We will discuss conclusions drawn from the literature relative to each of these three questions in turn.

To verify the hypothesis that stress in humans causes diseases usually associated with stress, one would have to show that the incidence of these diseases could be affected by some intervention capable of moderating the effects of stress. As yet, there is very little evidence that meets this test. As Cooper and Marshall (1976) point out, virtually all of the research on this question uses correlational data to link stress related diseases to exposure to stress. Similarly, data that suggest ways of reducing or influencing the effects of stress come from studies that correlate the occurrence of stress outcomes with physiological or behavioural patterns that are often thought to be connected with stress.

There has been some evidence (Kaplan, 1984) that dietary and exercise changes can reduce the risk of heart disease. However, this evidence is only beginning to appear in studies at the end of a line of studies that have attempted to demonstrate direct relationships between heart disease and so-called lifestyle behaviours. That is, it has only been with the application of stringent research design controls that some of this evidence has begun to emerge. Moreover, evidence on the effects of diet and exercise have a bearing on the relationship between stress and heart disease only if one assumes that the diet and exercise effects could counteract heart disease risk resulting from exposure to stress. In sum, the evidence supporting the truth of the hypothesis that stress causes disease remains circumstantial. This is not to say that the circumstantial evidence that exists is not convincing.

In addition to work on personal characteristics associated with stress, there has been a great deal of work on predisposing physiological factors, so called lifestyles factors, and other individual situational factors that might affect stress responses. However, the work on physiological factors, and lifestyle patterns affecting physiological health, has not led to precise conclusions about individual physiological differences and their relationships to stress. Kaplan (1984) in a review of behavioural programs aimed at preventing heart disease through changing dietary and exercise behaviour, points out that where behaviour-change programs have reduced the

behaviours leading to heart disease, they have not at the same time reduced the overall mortality risks. That is, the programs that have shown some reduction in heart attack fatalities have not shown a reduction in overall mortality; program participants who did not die of heart attacks, died of something else, apparently just as soon as they would have if they had had a heart attack.

The circumstantial evidence in support of the stress-disease hypothesis comes from adding up the results of very many individual but small findings, all of which tend to point in the same direction. But from the circumstantial evidence connected with the effects of stress, it is difficult to decide how to add up the evidence. A lot of individual findings reflect studies that are not truly independent studies, but instead, are all essentially the same study repeated over and over in slightly different conditions. The problem is compounded even more if, as many studies do, the link between stress and disease is assumed to be true to start with; and the studies then seek out correlations that turn out to support the original assumption.

Finding definitive answers to the second and third questions posed at the beginning of this section is just as difficult as finding a definitive answer to the first question. Studies addressed to questions about pre-disposing factors and interventions have also been predominantly correlational studies. They have also been predominantly studies that include a small set of variables, but without means for taking account of numerous uncontrolled variables that other studies have suggested as influences on stress reactions.

To give an indication of the overall complexity and, confusion that purveys research on stress causes and effects; Table 1 gives an aggregated display of factors that have been found or have been suggested to affect stress reactions. The Table is divided into four columns. The first column gives occupational factors that may produce stress; the second column gives factors that may moderate stress effects; the third column gives outcomes and symptoms of stress; and the fourth column gives suggested adaptive responses to stress.

From the table, it can be seen that there are few unexplored possibilities in the search for links between stress and the possible outcomes of stress. At the same time, there seems to be no way of constructing, from a table like Table 1, a practical profile of a person or a lifestyle that would be ideal for minimizing the effects of stress.

ANTECEDENTS

MODERATORS OF STRESS

OUTCOMES OF STRESS

ADAPTIVE RESPONSES

Intrinsic To The Job:

poor physical working conditions
work overload/underload
time pressures
physical danger
resource/technical problems
hours of work
variance in workload

Role in Organization:

role ambiguity
role conflict
responsibility for people
conflicts
position in the organization

Career Development:

under/over promotion
lack of job security
thwarted ambition
opportunity for advancement

Relationships at Work:

with boss
with colleagues
with subordinates

Organizational:

lack of participation in decision-making
restrictions on behaviour
size of organization/workgroup
bureaucracy
management style
reward system
union constraints
government laws and regulations

Extra-Organizational:

family problems
life crisis
financial difficulties

Demographics:

age
sex
social class
experience in job
education
race
occupation/tenure

Personality:

Type A
ego needs
tolerance for ambiguity
level of neuroticism
level of anxiety
motivation
psychological contract
introversion/extroversion
locus of control
approval seeking
defensiveness
impatience
self-esteem

Significant Others:

family support
supervisor/colleagues support

Training:

adequacy

Job Selection:

adequacy

Physical Stamina:

biological
neurological

Physical:

coronary heart disease
cardiovascular disease
diastolic blood pressure
cholesterol
increased heart rate
respiratory problems
gastrointestinal disorders
ulcers
headaches
skin disorders
BMI increases
gastric acid production
adrenaline/noradrenaline
lymph reduction
ACIN production
fatigue/insomnia

Behavioural:

smoking
escapist drinking
absenteeism
strikes/grievances
loss of concentration
drug abuse
over/under eating
nervous gesturing, pacing
risky behaviour (reckless driving, gambling)
aggression
vandalism/stealing
suicide/attempted suicide
procrastination
inattentiveness
vacillation in decision-making
inability to organize self
changes in job performance
dedication use

Cognitive/Affective:

mental ill health
job dissatisfaction
reduced aspirations
anxiety/tension
depression
low self-esteem
alienation
repression
withdrawal
regression
fixation
projection
negativism
fantasy
uncertainty about whom to trust
feelings of persecution

Individual:

attempt at self-understanding
relaxation techniques
acceptance of less than perfection
mastery of skills
seeking sympathy or social support
tension release (laugh, cry, attack)
seeking medical, psychological help
attempts to alter behaviour, personality style
planning, organizing each day's activities
biofeedback techniques
increased religious activity

Organization:

redesigning jobs
altering organizational structure
changing work schedule
providing feedback to employees aimed at role clarification
refine selection and placement procedures
making promotion criteria and career paths clear
providing health services

In view of the general findings, the conclusions that follow are:

1. The link between disease and exposure to stress remains one based on circumstantial evidence.
2. There is as yet no system or theory that comprehensively predicts risks of exposure to stress, or risks of stress outcomes.
3. There is as yet no comprehensive theory or system that prescribes interventions for preventing exposure to stress, or for reducing the effects of stress.

RESEARCH NEEDS

The primary research needs related to stress in vehicle operators is to establish whether or not stress is a significant problem for vehicle operators. This need exists in so far as there is very little evidence as to whether or not stress is a significant problem in vehicle operation. Although there are some suggestive bits of evidence to use for making a case that stress is a problem for vehicle operators, in general there is no apprehended problem that needs to be confirmed or disproved by research. For example, we have not found either any technical literature nor any popular literature suggesting a serious occupation-wide problem like stress in video display operators (Dainoff, 1979); or burnout in health care workers (Farber, 1983). Thus, the need for research to establish whether or not stress is a problem in vehicle operation would have to be based on a judgment about the need to find out rather than on the need to determine the validity of a belief widely held in either the industry or by the public.

If such research were to be conducted, the wisest course would be to conduct a mortality study to see whether or not vehicle operators show stress disease mortality patterns significantly different from other occupations.

Morbidity patterns could also be studied; however, doing such a study would require considerably more effort than a mortality study would. Most vehicle operation jobs require that operators be able to meet certain medical standards; and that these requirements be kept up-to-date on a regular basis. Consequently, it is generally practical to obtain up-to-date medical data for people in this occupation. However, it is difficult to find medical data for people in other occupations to compare with vehicle operator data. For other occupations in which medical standards are maintained, there are usually also different medical requirements to be met. Consequently, when different morbidity patterns show up in different occupations, it is difficult to determine whether the morbidity differences are due to differences in the occupations, or due to differences in medical standards. The only way around this problem is to sample from a wide enough spectrum of occupations so that, for example, morbidity in vehicle operation would be compared with something approximating a general population morbidity pattern.

The fact that medical records are maintained for most vehicle operators means that operators who showed signs of stress associated disease may be implicitly selected out of the vehicle operator occupation. Thus, a morbidity study, even with good sampling techniques for comparison data in other occupations, might show that vehicle operators suffer less from stress related disease than other occupations even though the occupation is intrinsically more stressful than other occupations.

Considering the relative difficulties of data collection and interpretation, a mortality study would be the most cost effective way of apprehending a problem with stress in vehicle operation. At this time, there are no strong indications that vehicle operation is more stressful than most other occupations. If there is a problem, it should show up in the mortality data.

Another approach to research would be to study vehicle operators

directly, either as a follow-up to some type of epidemiological study, or independently of an epidemiological study. Blau's study of bus operators represents a reasonably good model of the direct approach. The approach of using interviews, questionnaires, and company records to look at stress factors specific to the organization, and specific to jobs within the organization has been used in a number of occupational stress studies; and it seems to serve the purpose of providing reliable data. The main problem with this approach is not so much in collecting reliable data as it is in interpreting what the data mean. If one reviews the results of a typical occupational stress study, it is often difficult to see how the study would have been different if it had been conducted as a study of employee morale or job satisfaction. In fact, most of the organizational studies of stress have been motivated by, at least on the organization's side, by concerns about turnover, absenteeism, and other signs of low job satisfaction.

There have been some estimates of the costs of occupational stress; and the estimates that exist do not suggest a great deal of return on investing in occupational stress research. Cooper and Marshall quote some estimates: four billion (1963 dollars) in lost labour per year in the U.S. due to cardiovascular disease; and 22.8 million days of lost time in a year in the U.K. due to mental, neurotic, and other nervous incapacities. Both of these estimates would work out to something in the order of one day per year of lost time per worker. There are few organizations that would consider investing in a program to increase employee productivity by the equivalent of one person-working day per year; unless that is, the program was virtually certain to be successful. As Kaplan points out, overall mortality rates in the western world have not changed much since the turn of the century, and what change there has been, has been due almost totally to reductions in infant mortality. Thus, the likelihood that an occupational or organizational intervention would reduce human and economic losses related to stress is very small.

The things that an organization can do to improve human productivity seem still to be in traditional areas; selection, training, and management. For example, the estimated costs of lost time due to stress related disease in the U.S. is still only equal to or slightly less than (equating 1963 with 1983 dollars) the amount Hunter and Hunter (1984) estimate as the net benefit of using proper employee selection procedures in just the U.S. Federal Public Service. In fact, most of the stress outcomes commonly listed in occupational stress literature reflect the results of failing to select employees suited to the jobs they occupy; or failing to train employees adequately enough to do their jobs competently; or finally permitting inept managers and supervisors to carry on practices that hamper employees from working effectively and gaining reasonable satisfaction from their jobs.

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